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Growth Performance of Non-Food Grains Under the Crop Diversification Program (CDP) in Bangladesh

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ABSTRACT

The present study attempts to estimate the growth performance of non-food grains such as pulses, oilseeds, potato, mustard, groundnut and linseed in Bangladesh. The objectives of the study were to estimate the growth rates of acreage and production of these crops before the crop diversification program (CDP) period and during the CDP period using time series data from 1974/75 to 2007/08. The exponential growth rate model and analysis of variance (ANOVA) model were used in this study. The findings of the study indicated that the growth of area for the crops of pulses, oilseed and potato increased before pre-CDP periods and decreased for the crops of mustard, groundnut and linseed. However, the growth of production increased in pre-CDP periods for the all crops. On the other hand, only the crop area for potato increased during CDP period. Consequently the production of potato increased during CDP period. The stability test between the periods showed that the growth performance of areas for the crops of pulse, oilseeds, mustard, groundnut and linseed were better during crop diversification period than pre-crop diversification period. In case of potato, both the growth performance of area and production were better in pre-CDP periods than during CDP periods.

Keywords: Growth Performance, Crop Diversification Program, Production, and Statistical Model.

Introduction

In recent years, stagnation or very slow growth of potato, pulses and oilseeds played a significant role in our economy and is a serious concern

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for the planners and policy makers in Bangladesh. The contribution of the cultivated areas of pulses, oilseeds and potato of the major agricultural cropped areas are 5.45%, 4.47% and 1.09% and its production are 0.60%, 0.56% and 1.80% respectively (BBS, 1999). In regard to oilseeds, mustard and linseeds dominates the other minor oilseeds crops and its share in total oilseeds' cropped areas are 61.21% and 12.47%, whereas its production was 52.59% and 10.36%, respectively (BBS, 1999). Since oilseeds are the major source of oil in Bangladesh, the production affects the domestic availability of edible oil significantly. The continued stagnation in oilseeds production and ongoing rising demand for edible oil has led to an ever widening gap between their supply and demand and this gap is filled up by imports.

Fish and meat are the main source of protein in Bangladesh but in recent years there has been a huge shortage in fish and meat consumption in Bangladesh. To make up the deficiency in protein, pulses can play a role of cheap protein supplier in the absence of animal proteins. On the other hand, potato is one of the main sources of starch and the people of Bangladesh are showing tendencies to choose potato based food instead of rice. Thus, potato also plays an important role in substituting rice consumption in Bangladesh.

This paper attempts to compare the growth rate of areas and production of potato, pulses and oilseeds between the period 1974-75 to 1985-86 (pre-crop diversification program - CDP) and the period 1986-87 to 2007-08 (the CDP period) and also to explore the stability of the growth rates between the pre CDP period and during the CDP period.

There was a large number of research on pulses, oilseeds, mustard, linseed, potato and groundnut in the subcontinent especially in India (Ramasamy and Selvaraj, 2002; Joshi and Saxena, 2002 and Kumar et al., 2002). Most of the researchers conducted research on particulars slow growth crops such as pulses, mustard, oilseed, potato, linseed, groundnut and so on using secondary data. They estimated the growth performances of areas and production of slow growth crops. In addition, Indian Society of Agricultural Economics have organized two annual conferences on slow growth crops such as oilseeds, potato, groundnut, linseeds, mustard etc and a large number of abstracts of the presented papers were accumulated in the special issues (Vol. 48, pp.373-447, 1993 and Vol. 57, pp. 372-416, 2002). However, only few researchers have conducted research on pulses, oilseeds, potato, (Haque, et. al., 1996; Akbar, 1995;

Ahmed, 1984) and other field crops, and they estimated the growth rates over the period, but they did not explore the growth rates of these crops during the CDP period and pre-CDP period. This paper aims to estimate the growth rates of areas and production of the pulses, oilseeds and potato between the pre CDP and CDP period and also determine the structural break of the two periods. It is, therefore, expected that the study will provide useful information for the policy makers of Bangladesh.

Methodology of the Study

The present study is based on the secondary data collected from Bangladesh Bureau of Statistics (BBS) published by the Ministry of Planning of Bangladesh Government (For detials, Appendix A and B). Time series data were used to estimate the exponential growth rates of area and production of pulses, oilseeds, potato, mustard, groundnut and linseed for the pre CDP (1974/75 to 1985/86) and the CDP periods (1986/87 to 2007/08). Dummy variables techniques were used to find out the stability of growth rates of these crops between the two periods. The crop areas and production are calculated in acres and metric ton respectively.

Analytical Techniques

On the basis of the objectives, different growth rate models such as linear regression model, semi-log model, double-log model, log-log inverse model and reciprocal model have been run. But among the above models the double-log model seems the most appropriate to analyze the data. An exponential function of the following form was fitted to the data to compute the growth rates of areas and production of pulses, oilseeds, potato, mustard, groundnut, and linseed:

$$Y_{it} = a_i e^{b_i t}$$

$$or\ \ln Y_{it} = \ln a_t + b_i t \quad (i = 1, 2, 3, ...6 \quad and\ t = 1, 2.....34)$$

where, ln= Natural logarithm and b is the growth rate. Percentage of exponential growth rate was expressed by multiplying b with 100. Such a

model has been used to estimate the growth performances of different varieties in Bangladesh (Alam, 1992).

There are two methods that can be used to find out the structural break between two periods. These are the chow test as suggested by Chow (1960) and the dummy variable technique. But the dummy variable technique is better fitted than the chow test to trace the structural break between the pre CDP period and the CDP period. The following model was applied to study the stability of the growth rates of areas and production between the pre and post CDP periods:

$$\log A_{it} = \log \alpha_{i0} + \alpha_{i1} t + \alpha_{i2} D_1 + \alpha_{i3} (D_1 t) + u_{it}$$

$$\log P_{it} = \log \beta_{i0} + \beta_{i1} t + \beta_{i2} D_1 + \beta_{i3} (D_1 t) + v_{it}$$

$$where, i = 1, 2, ...6 \quad and \ t = 1, 2, ...34$$

A and P denote area and production, respectively.

i = Pulses, oilseeds, potato, mustard, groundnut, and linseed

t = Time trend

D = 1, for pre-CDP period;

= 0, other wise

β_0 = intercept

α_1, α_2, α_3 = Regression coefficients of crop area.

β_1, β_2, β_3 = Regression coefficients of crop production.

Durbin-Watson (D-W) (Koutsoyiannis, 1977) statistic was used to detect the autocorrelation of the area and production of pulses, oilseeds, potato, mustard, groundnut, and linseed from 1974/75 to 2007/08.

Results and Discussions

The growth performances of main non-food agricultural crops such pulses, oilseeds, potato, mustard, groundnut, and linseed are presented in Table 1, Table 2 and Table 3. Table 1 shows the rate of growth of areas for all crops for pre CDP (1974/75-1985/86) and during CDP (1986/87-2007/08) periods, Table 2 shows the rate of growth of

production of all crops for pre CDP and the CDP periods, and Table 3 reflects the rate of growth of areas and productions, of all crops for the year 1974/75 to 2007/08.

The areas of pulses have increased significantly in pre-CDP; however, it has declined significantly during the CDP periods (Table 1). As a result, production has significantly increased in pre-CDP period but declined during CDP periods (Table 2). In general, for both periods, it can be said that the cost-benefit ratio of pulses compared to other crops, especially to *boro* rice, have discouraged farmers from pulses production. Categorically, different reasons can also be spelled out for two periods. Pulses are rich source of protein; therefore, these can supplement the costly animal protein in the country. Bangladesh is essentially poor in protein supply. When the malnutrition was a lesser concern to the government in the pre CDP period, pulse production had received less priority in the cropping plan. As such, pulse area and production did not increase in this period. In addition, unfavorable cost-benefit ratio of pulses, natural hazards might have affected areas and production after 1985/86. On the other hand, Figure 1 and Figure 2 reveal that both areas and production of pulses have increased rapidly in 1985/86 and could not keep the same pace, so both areas and production have declined sharply in the following years. This can be explained by the fact that the program could have supported producers at the beginning of the program. So the farmers were encouraged and consequently, both areas and production have increased since the beginning. But, over time, the CDP program could not keep pace with the interest of the farmers. This, coupled with unfavorable benefit-cost ratio, disasters, inadequate extension support, increased emphasis on HYV rice and wheat (Ministry of Planning, 2000) which might have affected the growth rate of areas and production of pulses during the CDP period. Almost a similar explanation can be given for mustard, and groundnut. Nevertheless, growths of potato and linseed areas and production have significantly increased in both periods. This explains the fact that the benefit-cost ratios of these two crops were much favorable to farmers compared to the crops discussed above.

TABLE 1. Exponential growth rate of areas of pulses, oilseeds, potato, mustard, groundnut and linseed from the period 1974-75 to 1982-83 and 1985-86 to 2007-08

Crops	1974-75 to 1985-86				1986-87 to 2007-08			
	Coefficients	R^2	T-ratio	D-W	Coefficients	R^2	T-ratio	D-W
Pulses	0.08184* (0.02393)	0.54	3.42	1.12	-0.048136* (0.004957)	0.83	-9.71	0.33
Oilseeds	0.05973* (0.01829)	0.52	3.27	1.04	-0.028557* (0.004957)	0.82	-9.47	0.41
Potato	0.023595* (0.005680)	0.63	4.15	1.76	0.063347* (0.004958)	0.89	12.78	0.91
Mustard	-0.003753 (0.003106)	0.13	-1.21	1.53	-0.010372*** (0.006135)	0.13	1.70	0.66
Groundnut	-0.006685 (0.008470)	0.06	-0.79	0.77	-0.008304 (0.005914)	0.09	1.40	0.98
Linseed	-0.006882 (0.004307)	0.21	-1.60	0.94	-0.13093* (0.03167)	0.46	-4.13	0.65

Notes: (i) *, ** and ** indicate 1%, 5% and 10% level of significance, respectively.

(ii) The figures in parentheses indicate standard error.

(iii) D-W indicates Durbin-Watson statistic.

TABLE 2. Exponential growth rate of production of pulses, oilseeds, potato, mustard, groundnut, and linseed from the period 1974-75 to 1985-86 and 1986-87 to 2007-08

Crops	1974-75 to 1985-86				1986-87 to 2007-08			
	Coefficients	R^2	T-ratio	D-W	Coefficients	R^2	T-ratio	D-W
Pulses	0.07885* (0.02618)	0.48	3.01	0.97	-0.039013* (0.004573)	0.78	-8.53	0.31
Oilseeds	0.06672* (0.01549)	0.65	4.31	1.04	0.009658 (0.007044)	0.09	1.37	0.84
Potato	0.035976 * (0.006917)	0.73	5.20	1.73	0.086585* (0.005780)	0.92	14.98	0.84
Mustard	0.07968* (0.01975)	0.62	4.03	0.99	-0.004577 (0.003087)	0.10	-1.48	0.67
Groundnut	0.0156 (0.01119)	0.16	1.39	1.60	-0.004351 (0.003933)	0.06	-1.11	1.10
Linseed	1.2793* (0.2993)	0.63	4.17	1.02	-0.15285* (0.02875)	0.59	-5.32	0.60

Notes: (i) *, ** and ** indicate 1%, 5% and 10% level of significance, respectively.

(ii) The figures in parentheses indicate standard error.

(iii) D-W indicates Durbin-Watson statistic.

TABLE 3. Exponential growth rate of areas and production of pulses, oilseeds, potato, mustard, groundnut and linseed from 1974-75 to 2007-08

Crops	Area				Production			
	Coefficients	R^2	T-Ratio	D-W	Coefficients	R^2	T-Ratio	D-W
Pulses	0.003166 (0.006903)	0.09	0.46	0.24	0.009747 (0.006651)	0.07	1.47	0.25
Oilseeds	0.005127 (0.004673)	0.04	1.10	0.27	0.023926* (0.004009)	0.53	5.97	0.66
Potato	0.042341* (0.003145)	0.85	13.46	0.48	0.056639* (0.004103)	0.86	13.81	0.37
Mustard	0.013380* (0.003744)	0.29	3.57	0.31	0.019397* (0.004176)	0.41	4.64	0.4
Groundnut	0.013819* (0.003710)	0.32	3.72	0.47	0.013969* (0.002873)	0.43	4.86	0.67
Linseed	-0.01275 (0.01827)	0.02	-0.70	0.32	-0.01496 (0.02021)	0.02	-0.74	0.27

Notes: (i) *, ** and ** indicate 1%, 5% and 10% level of significance, respectively.

(ii) The figures in parentheses indicate standard error.

(iii) D-W indicates Durbin-Watson statistic.

Table 1 and Table 2 show that the rate of growth (areas and production) of some crops have declined within the priods, yet Table 3 reveals that the rate of growth of areas and productions of pulses, oilseeds, potato, mustard, and groundnut, have increased over the years 1974/-75 to 2007/08, except linseed. It shows that the rate of growth of areas and productions of potato, mustard, and groundnut has increased significantly in Bangladesh over the years. All the coefficient values were statistically significant at 1% level. This implies that the CDP has positively influenced the growth of areas and production of pulses, potato, mustard, groundnut except linseed. The area and production of linseed have decreased over the years because the farmers have lost their interest to grow linseed. The main reason is that the people do not like edible oil of linseed like other edible oil. Unfortunately, this growth was not enough to meet the nutritional deficiency of the country.

Previous two analyses suggested that decline in pulse area in the CDP periods have reduced its production. Similar conclusions were made for the areas of oilseed. However, the areas for the crops of mustard, groundnut and linseed have declined during both pre-CDP and the CDP

periods. On the other hand, the crop area for the potato has increased during pre-CDP and CDP periods. The main reason for this is that potato is a profitable enterprise rather than other crops. Though the areas have increased in pre-CDP period and post harvest period, production showed positive with area for both the periods. This could be explained by the fact that more has been done for potato compared to other crops in the pre and the CDP periods. The main reason is that the potato is more profitable enterprise compare to other non-food grains crops such as pulses, oilseeds, mustard, groundnut and linseed.

From Figure 1 and Figure 2 it can be concluded that at the beginning of the crop diversification program, the areas and the production of pulses, oilseeds, potato, mustard, groundnut and linseed have rapidly increased while during the period the areas of the pulses, oilseeds decreased gradually, and consequently the production of pulses, oilseeds and mustard decreased at the same time.

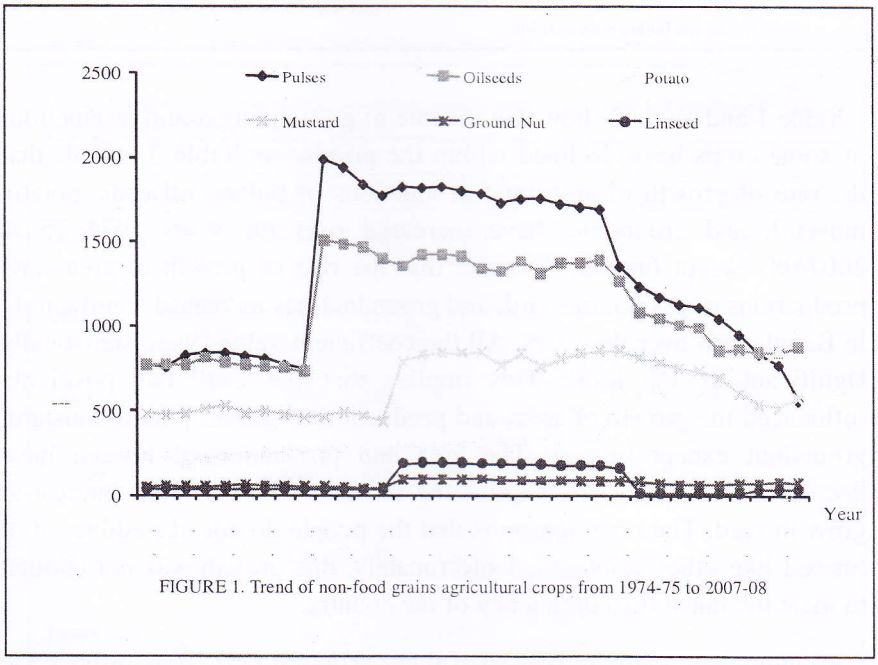

FIGURE 1. Trend of non-food grains agricultural crops from 1974-75 to 2007-08

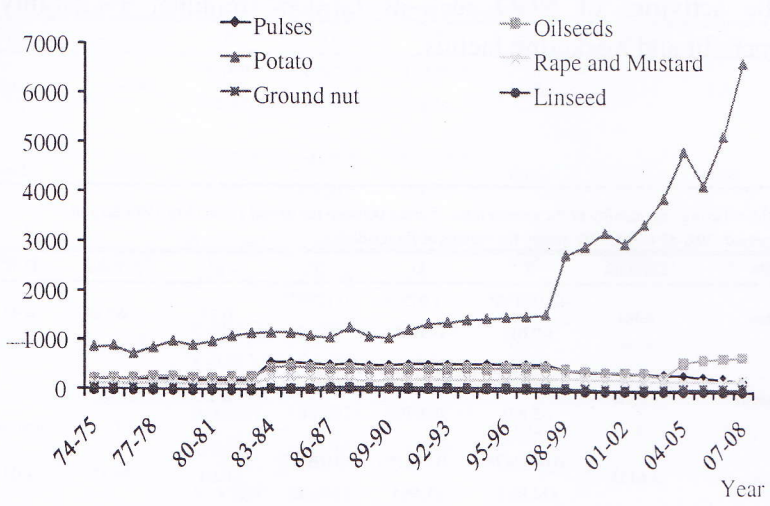

FIGURE 2. Trend of non-food agricultural crops from 1974-75 to 2007-08

Stability Test of Growth Rate of Area and Production

The stability test of the growth rates between the sub-period 1974-75 to 1985/86 and 1986/87 to 2007/08 are presented in Table 4. It appears from the table that for the growth rate of mustard, and linseed areas, the differential intercept and slope coefficients are insignificant. This indicates that there are no significant differences between the growth of areas in the two sub-periods. But in case of pulses, oilseeds, potato and linseed, both differentials intercept and slope coefficients are statistically significant at 1% level of significance. Thus one may accept the hypothesis that there was definitely a shift in the level of growth rates of areas under the crop pulses, oilseeds, potato and linseed. Since the slopes of the dummies were negative for the areas pulses, oilseeds, potato and linseed and statistically significant at 1% level, the growth performance was better in 1974/75 to 1985/86 than in the period 1986/87-2007/08. On the other hand, the slope dummy of the area of potato is positive and it was statistically significant at 1% level, which indicates the growth performance was better in CDP period than pre-CDP period. It may,

therefore, be concluded that there were significant differences in the growth performance in the two sub period for these crops mainly because of the activities of NGO such as farmers' training, availability of microcredit and marketing facility.

TABLE 4. Testing the stability of the growth rates of areas between the period 1974-75 to 1985-86 and the period 1986-87 to 2007-08 among the regions of Bangladesh

Crops	Constant	T	D	DT	R^2	F-Value	D-W
Pulses	8.341	-0.048136* (-7.01)	-1.9759* (-9.44)	0.12997* (7.05)	0.75	1087.47	0.97
Oilseeds	7.7301	-0.028557* (-5.82)	-1.3133* (-8.79)	0.08829* (6.71)	0.73	818.27	1
Potato	4.6135	0.063347* (14.88)	0.7361* (5.68)	-0.03975* (-3.48)	0.93	50.33	1.05
Mustard	6.8326	-0.010372** (-2.05)	-0.6247* (-0.1837)	0.00662 (0.49)	0.69	20.58	1.23
Groundnut	4.5759	-0.008304 (-1.59)	-0.5572* (-3.51)	0.00162 (0.12)	0.65	10.606	1.25
Linseed	7.2077	-0.13093* (-5.06)	-3.6018* (-4.57)	0.12405** (1.79)	0.50	21.49	0.85

Notes: (i) *, ** and ** indicate 1%, 5% and 10% level of significance respectively.

(ii) The figures in parentheses t-statistics.

(iii) D-W indicates Durbin-Watson statistic.

TABLE 5. Testing the stability of the growth rates of production between the period 1974-75 to 1985-86 and the period 1986-87 to 2007-08 among the regions of Bangladesh

Crops	Constant	T	D	DT	R^2	F-Value	D-W
Pulses	6.948	-0.039 (-5.47)	-1.8473* (-8.51)	0.11787* (6.16)	0.72	1402.24	0.91
Oilseeds	5.903	0.009658 (1:42)	-0.6628 (-3.21)*	0.05706* (3.14)	0.66	55.58	0.9
Potato	5.636	0,086585* (17.37)	1.0165* (6.69)	-0.05061* (-3.79)	0.95	49.90	1.06
Mustard	5.522	-0.004577 (-0.88)	-1.0508* (-6.60)	0.08426* (6.01)	0.76	128.98	0.95
Groundnut	3.772	-0.004351 (-1.05)	-0.5622* (-4.47)	0.01995*** (1.80)	0.84	35.30	1.52
Linseed	6.443	-0.15285* (-6.04)	-5.1638* (-6.70)	0.32221* (4.75)	0.61	1305.49	0.72

Notes: (i) *, ** and ** indicate 1%, 5% and 10% level of significance respectively.

(ii) The figures in parentheses t-statistics.

(iii) D-W indicates Durbin-Watson statistic.

Table 5 shows the results of stability test of the growth rates of production of pulses, oilseeds, potato, mustard, groundnut and linseed between the sub-period 1974/75 to 1985/86 and the period 1986/87 to 2007/08. Table 5 further shows that the slope coefficients for the production of mustard, and groundnut crops are insignificant but the differential intercept were statistically significant at 1% level. This indicates that there were no significant differences between the growth rates of mustard, and groundnut production in the two sub-periods. In case of potato, the differential intercept is statistically significant but the slope was negative and it was at 1% level of significance. So it may be concluded that the growth performance of the pre crop diversification period was better than the crop diversification period. But in case of pulses, oilseeds and linseeds both the differential intercept and slope coefficients were statistically significant at 1% level. These indicate that there were structural break in the level of the growth rate of production of pulses, oilseeds and linseeds between the period 1974/75 to 1985/86 and the period 1986/87 to 2007/08. It is interesting to see from the table 5

that the production performance of pulses, oilseeds, mustard, groundnut and linseed (negative slope of dummies) for the period 1974/75 to 1982/83 was better than that of the crop diversification period. But the growth performance of potato was better in crop diversification period (CDP). In case of mustard, the differential intercept is significant at 1% level but the differential slope is insignificant. Thus one may conclude that the structural break has occurred at the level of production between the two periods but the growth performance is same in both the periods for this product.

Conclusions and Recommendations

The production of agricultural crops can be increased either through expansion of cropped land or improvements in productivity of the cropped land. In the context of Bangladesh there is little scope for expansion of net cultivated area to increase production. Productivity improvements can increase the total production of agricultural crops. There are numerous physical, technological, economic and institutional constraints on increasing area and per acres yield rates of potato, oilseeds and pulses. Lack of high yielding varieties suitable for the soil condition, lack of institutional credit facilities, unattractive prices, and lack of institutional mechanism for integrating production, processing and marketing of potato, oilseeds and pulses are some of the major factors responsible for the stagnation of the potato, oilseeds and pulses economy. In the period 1985/86, the CDP started activities extensively and at that time CDP crops like potato, oilseeds and pulses brought a break-through in the cereal crops. Before CDP, crops like potato, oilseeds and pulses occupied an insignificant place in the cropping pattern. Consequently in the pre-CDP period, the growth rate of cropped areas for potato, oilseeds and pulses, and their production were lower than that of the CDP period. While the CDP started in 1985/86, the cropped areas and its production jumped suddenly due to the NGO's encouragement activities such as farmers' training, availability of microcredit, and marketing facilities. Therefore, at the beginning, the cultivators were encouraged to expand the cropped land. But during the CDP period, these cropped areas reduced gradually in the absence of CDP activities. Therefore, the policy makers should look for alternative policies for removing the shortage of these crops.

AUTHOR NOTES

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APPENDIX A. Areas ('000 acres) of pulses, oilseeds, potato, mustard, groundnut and linseed from 1974/75 to 200708

Year	Pulses	Oilseeds	Potato	Mustard	Ground Nut	Linseed
1974-75	765	764	232	485	48	35
75-76	755	769	237	477	55	35
76-77	823	765	191	480	52	36
77-78	835	808	222	509	52	36
78-79	838	779	239	526	58	36
79-80	819	768	238	482	62	36
80-81	804	760	252	498	57	37
81-82	766	749	262	477	59	37
82-83	742	726	272	461	54	36
83-84	1985	1503	272	464	52	36
84-85	1938	1478	275	490	50	31
85-86	1837	1462	268	471	43	32
86-87	1770	1393	263	436	46	34
87-88	1822	1351	305	785	95	186
88-89	1817	1415	275	825	94	189
89-90	1823	1418	288	836	95	190
90-91	1799	1407	306	838	95	191
91-92	1783	1334	311	840	96	186
92-93	1726	1319	320	763	88	185
93-94	1752	1381	324	832	88	184
94-95	1755	1307	325	760	88	181
95-96	1721	1370	327	803	88	174
96-97	1702	1368	331	831	86	173
97-98	1690	1386	337	849	86	173
98-99	1351	1264	605	850	86	159
99-00	1231	1078	601	812	84	11
2000-01	1170	1040	615	785	72	11
01-02	1126	1001	587	749	64	11
02-03	1108	988	606	735	66	11
03-04	1040	850	669	690	64	11
04-05	947	860	806	597	71	12
05-06	833	845	744	536	73	34
06-07	769	841	853	520	81	35
07-08	558	874	993	577	77	31

APPENDIX B. Production ('000 metric ton) of pulses, oilseeds, potato, mustard, groundnut and linseed from 1974/75 to 200708

Year	Pulses	Oilseeds	Potato	Mustard	Ground nut	Linseed
1974-75	224	224	866	114	26	6
75-76	220	238	889	110	31	7
76-78	230	235	724	112	23	7
77-78	238	264	849	132	27	7
78-79	226	265	985	135	28	7
79-80	214	246	903	116	26	7
80-81	211	250	983	122	25	7
81-82	205	255	1095	123	24	8
82-83	203	253	1149	122	23	8
83-84	551	468	1166	254	33	41
84-85	553	487	1159	285	32	37
85-86	519	469	1102	261	34	37
86-87	510	437	1069	229	34	43
87-88	539	449	1276	222	48	43
88-89	496	434	1089	207	45	47
89-90	512	438	1066	217	41	48
90-91	523	448	1237	228	41	55
91-92	519	440	1366	243	42	50
92-93	517	449	1384	218	39	49
93-94	530	472	1438	239	41	48
94-95	534	453	1468	219	40	49
95-96	523	471	1492	246	40	46
96-97	525	478	1508	249	40	50
97-98	519	483	1553	254	40	50
98-99	417	448	2762	253	39	46
99-00	384	406	2933	249	42	3
2000-01	366	385	3216	238	32	3
01-02	344	376	2994	233	30	3
02-03	349	368	3386	218	34	2
03-04	333	270	3908	210	34	3
04-05	316	587	4856	191	39	3
05-06	279	657	4161	183	38	8
06-07	258	684	5167	189	46	8
07-08	204	701	6648	228	44	8